REMARKS

Claims 1-22 are currently pending in the subject application, and are presently under consideration. Claims 1-10 are allowed. Claims 11-20 are rejected. Claims 11 – 13, 16, and 18 have been amended. Claims 21 and 22 have been added. Favorable reconsideration of the application is requested in view of the amendments and comments herein.

I. Rejection of Claims 11-20 Under 35 U.S.C. §103(a)

Claims 11-20 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Melanson U.S. 6,346,898 in view of Ribner, et al. (U.S. 5,142,286). Withdrawal of this rejection is respectfully requested for at least the following reasons.

Melanson describes a delta-sigma analog-to-digital converter, generally comprising a noise shaping filter element fed into a multilevel quantizer. The output of the delta sigma modulator is fed through a digital-to-analog converter (DAC) array in a feedback loop to the noise shaping filter. Dynamic element matching circuitry is included in the quantizer, in a reference path. The quantizer includes dynamic element matching circuitry for shaping the usage of the elements of the quantizer. Specifically, reference voltages are switched to specific comparators according to control signals from switch control circuitry.

Ribner describes a system for converting analog output from a photo sensor into digital data via sigma-delta analog-to-digital conversion. A preamplifier generates an analog output signal responsive to the photocurrent of the photo sensor. The analog output signal is undesirably accompanied by wideband noise. The analog output signal is supplied to a sigma-delta analog-to-digital converter. A decimation filter within the sigma-delta converter suppresses noise arising from the quantization noise from the sigma-delta modulator portion of the analog-to-digital converter, as well as a component arising from wideband noise from the preamplifier.

Claim 11, as amended, recites a method for providing an analog feedback signal in a multi-bit delta-sigma analog-to-digital converter (ADC). A digital output signal, having a first word-size, is generated by a multi-bit delta-sigma analog-to-digital converter from an analog input. The digital output signal is then preprocessed to shift quantization noise away from a

frequency band of interest. The preprocessed digital output signal is then quantized to a digital feedback signal having a second, smaller word-size. The digital feedback signal is then converted to an analog signal to provide a feedback signal to the multi-bit delta-sigma analog-to-digital converter.

Neither Melanson nor Ribner teach or suggest the recited method. The Office Action cites Fig. 4 of Melanson as providing a teaching of generating a digital feedback signal for an ADC from an analog input, quantizing a digital feedback signal to obtain a second digital feedback signal having a smaller word-size, and converting the second digital feedback signal into an analog signal. Fig. 4 illustrates an example of a DAC utilizing a plurality of noise shaping elements for dynamic element matching prior to the digital-to-analog conversion. As the figure illustrates, there is no conversion of an analog signal into a digital signal, as the system begins with a digital input. In fact, there is no analog signal whatsoever until the system output, and the output signal is not employed as a feedback signal. Likewise, there is no analog feedback signal provided to an ADC, as there is no ADC in the system.

The element matching components in Fig. 4 of Melanson are implemented upstream of the signal conversion. Accordingly, Fig. 4 does not teach the conversion of a feedback signal from a first format (*e.g.*, digital) to a second format (*e.g.*, analog). Such a conversion would not be useful in the element matching system of Fig. 4. Similarly, the noise shapers used in element matching would be operating on an analog input signal obviating the need for a digital-to-digital quantization process in the noise shaping. It is thus respectfully submitted that Melanson does not teach or suggest the elements of claim 11.

Ribner does not remedy the described deficiencies of Melanson. It is respectfully submitted that Ribner does not teach preprocessing a digital feedback signal to shift quantization noise away from a frequency band of interest and quantizing the digital feedback signal from a first word-size to a second word-size. The decimation filter cited by the Office Action merely attenuates frequencies that are not of interest within the digital output of the system. It does not shift quantization noise away from a frequency band of interest. In fact, as in the present

invention, the feedback signals in Ribner are acquired prior to the application of the decimation filter (*See* Fig. 3). Accordingly, the filter is never applied to a feedback signal at all. Further, Ribner does not teach or suggest quantization of a digital feedback signal from a first word-size to a second-word-size. Neither Melanson nor Ribner, alone or in combination, teach and suggest the elements recited in claim 11. Accordingly, it is respectfully submitted that claim 11 is patentable over Melanson in view of Ribner.

Turning to claims 12 -15 and 21, which depend from claim 11, the applicant asserts that each dependent claim has its own specific elements and features that define patentable features over the cited references. For the sake of brevity, the discussion of certain dependent claims will be omitted. In focusing the discussion on specific claims, a concession of the patentable distinctiveness of the others is not intended. It will be appreciated that each of the dependent claims contains each and every element recited in claim 11. Therefore, claims 12 – 15 and 21 are allowable for at least the reasons set forth above,

Claim 13 recites a method in which the generation of a digital signal further comprises preprocessing the analog input signal to shift quantization noise associated with the analog-to-digital converter according to the analog feedback signal, quantizing the preprocessed analog signal to produce the first digital signal, and filtering the preprocessed analog signal to attenuate quantization noise associated with the analog feedback signal. The present invention teaches the use of a tunable filter within the noise shaper to mitigate noise caused by the quantization of the feedback signal. It is respectfully submitted that neither Melanson nor Ribner alone or in combination teach or suggest filtering an analog input signal for the purpose of eliminating quantization noise associated with an analog feedback signal.

Claim 16 has been amended to include the matter stated to be allowable in the Office Action. Specifically, claim 16 now recites means for delta-sigma modulating an N-bit digital output signal to produce an M-bit digital feedback signal, where M is a positive integer less than N. Accordingly, it is respectfully submitted that claim 16, and its dependent claims 17 – 20 and 22, are allowable over the cited art.

For the reasons described above, claims 11-20 should be patentable over the cited art. Accordingly, withdrawal of this rejection is respectfully requested.

II. New Claims 21 and 22

Claim 21, which depends from claim 11, recites a method wherein the quantizing of the preprocessed digital output signal into a digital feedback signal is performed by a delta-sigma modulator. Claim 22, which depends from claim 16, recites a system in which the means for delta-sigma modulating comprising means for shifting quantization noise away from a frequency band of interest. None of the references teach or suggest the elements recited in the new claims 21 and 22. Accordingly, it is respectively submitted that claims 21 and 22 are allowable for the reasons cited under their respective base claims and for their own unique elements.

CONCLUSION

In view of the foregoing remarks, Applicant respectfully submits that the present application is in condition for allowance. Applicant respectfully requests reconsideration of this application and that the application be passed to issue.

Please charge any deficiency or credit any overpayment in the fees for this amendment to our Deposit Account No. 20-0090.

Respectfully submitted,

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